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CADASTRAL DATA

Historically, the term *cadastre* has referred to a detailed register, inventory, statement of public record, of lands, their extent, ownership lists, assessment roll, statement of value, etc; used for the purpose of justly apportioning taxes on property. In modern times, with the advent of GIS and other elements of information technology, the use of the term *cadastre* is evolving. In the context of a local governmental multipurpose land information system (LIS), the term *multipurpose cadastre* is used to describe a system that is designed to record, store, and provide not only land-tenure and land valuation information but also a wide variety of information that can be functionally related to and referenced by property parcels. It is truly multipurpose in that it not only receives information and data from many sources, but it also provides services and products for many purposes and to many users.

For the average person, the most common manifestation of cadastral data is an ownership or parcel map. Cadastral data is both information in a graphic form about parcels, most commonly referred to as a parcel map, and tabular database information tied to the parcel map via a parcel identification number (PIN). The parcel map(s) include the boundaries of land interests for these parcels. The parcel map may be called a variety of names, including plat map, assessor's map, tax map, or cadastral map.[1]

A Cultural Land Information System. In describing and developing a multipurpose land information system, it is helpful to conceptualize two distinct ways of relating to divisions in the Earth's surface: natural and cultural. Natural LIS's refer to the many ways that the Earth is divided according to its physical characteristics such as soils, vegetation, mineral resources and waterways. Cultural LIS's are concerned with the divisions of the Earth into parcels by humans for purposes of ownership and use. Figure 17. illustrates the relationship between the Natural LIS and Cultural LIS in a multipurpose land information system, and how they are tied together through a common geodetic reference framework and base maps. *The heavily-outline portion of Figure 17. highlights the necessary components of a multipurpose cadastre.*

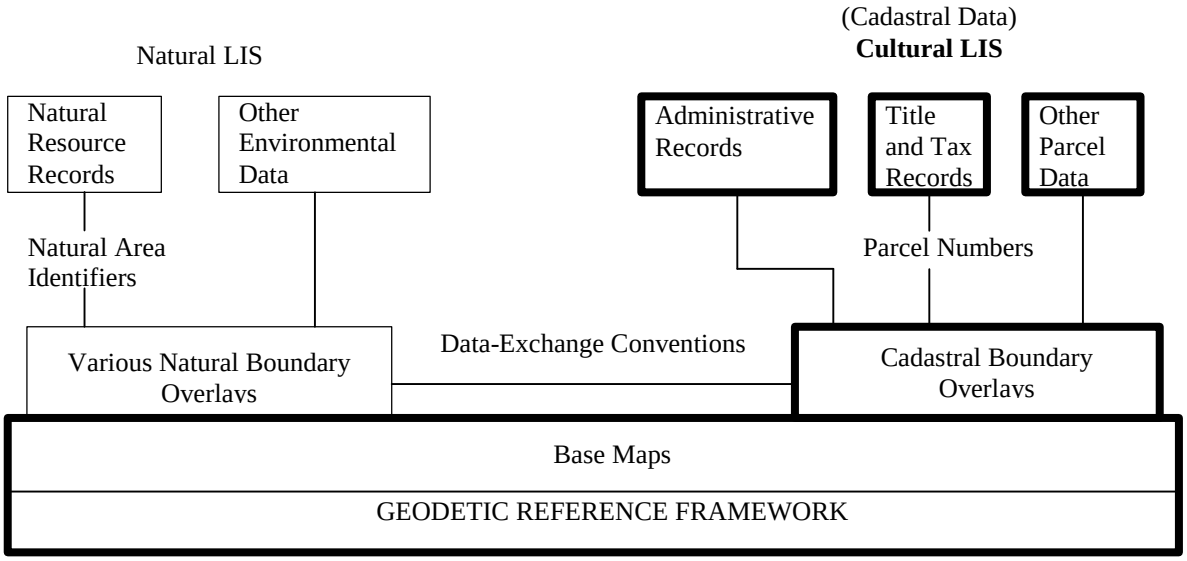

Figure 17. Components of a Multipurpose Land Information System (from NRC, Procedures and Standards for a Multipurpose Cadastre, 1983)

[1] Federal Geodetic Control Committee, January 1993:Multipurpose Land Information Systems, The Guidebook," The Parcel Map", 13-2 p.

The multipurpose cadastre is the core module of a local government multipurpose land information system designed to serve both public and private agencies, and individual citizens, by (1) employing the proprietary land unit (cadastral parcel) as the fundamental unit of spatial organization of land information and (2) employing local government land-record offices as the fundamental unit for information dissemination.[2]

> ***In a GIS/LIS, the cadastral layer contains the boundaries of property ownership and other rights to land. Many of the applications that use the cadastral layer involve overlaying other layers such as soils, flood plains, or zoning to determine property parcel characteristics or relationships to certain conditions. To support these types of applications, it is necessary to register accurately the spatial locations of various layers to each other. It is equally important to place the parcel boundaries in their accurate spatial locations and to portray their proper geometric shape as found in legal descriptions.[3]***

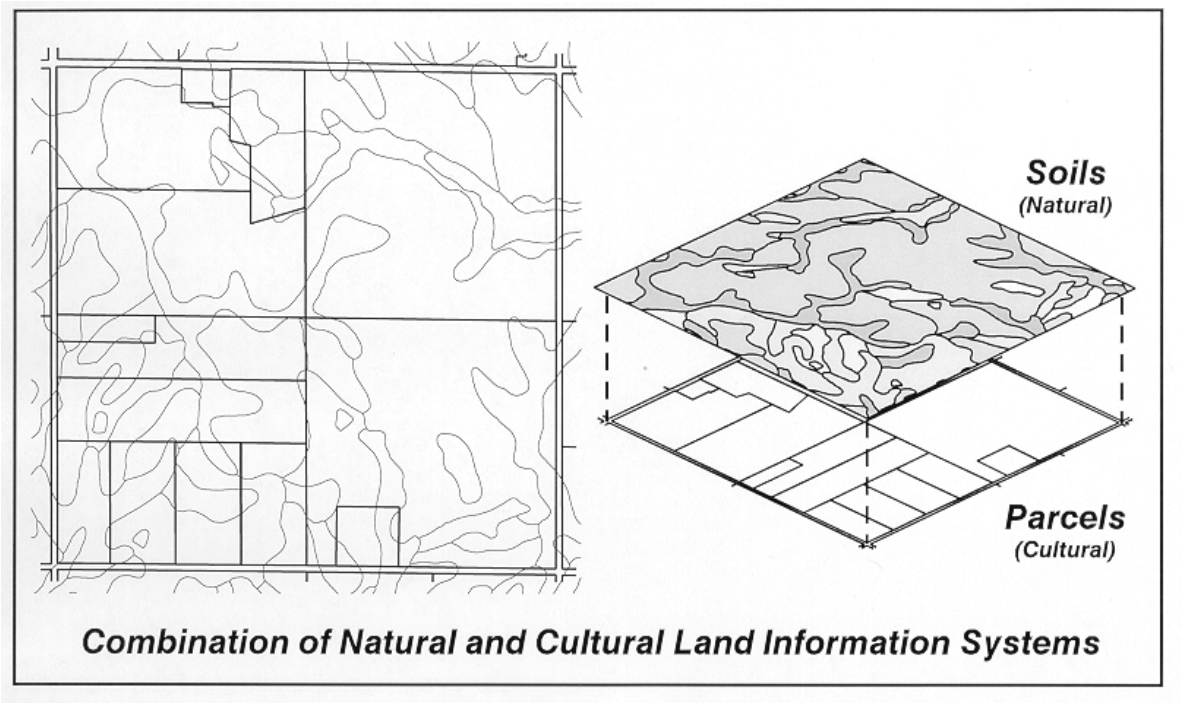

Fig. 18. An example of the combination of a natural and cultural data layer in a Multipurpose Land Information System.

Legal Aspects. The cadastral features are unlike the natural Earth features in that they are based on legal descriptions rather than on the location of physical features on the Earth's surface. They should be monumented on the land, although often the markers are not adequate. In some cases, the property corners were never marked, while in other instances the survey monuments have been lost or destroyed. In addition, surveys vary in levels of accuracy. Mapping of cadastral features often can be difficult. In many instances, confusing legal descriptions must be deciphered and conflicts between legal and physical aspects of location must be reconciled.

Property parcel boundaries are usually described in narrative form on a deed. The description records boundary measurements as metes and bounds or as bearings and distances. In Nebraska, the descriptions

[2] National Research Council, 1983: *Procedures and Standards for a Multipurpose Cadastre,* National Academy of Sciences, Washington, DC, 15-16 p

[3] Antenucci, John C., Kay Brown, Peter L. Croswell, et al., 1991: *Geographic Information Systems - A Guide to the Technology,* Van Nostrand Reinhold, New York, NY, 120 p

commonly refer to the Public Land Survey System (PLSS) township, range, section, and aliquot parts (half- and quarter-sections). As was discussed in Section VII, the PLSS was laid out by the federal government during the non-native settlement of the country, dividing land areas into townships of thirty-six one-square-mile sections. Land title was originally recorded or "patented" on the basis of these units and has often been resold through some uniform division or combination of them. It was to provide this underlying legal, geographic reference framework for the location and shape of property parcels, that the development of a PLSS base map was urged in the previous section of these guidelines.

In more densely settled areas, a further government approved subdivision of land is commonly described in subdivision plats that consist of a map, typically at a large scale of 1" = 20' to 1" = 200' for urban and suburban areas, with parcel identifiers and boundary dimensions. As part of these subdivision plats, land has been further subdivided into blocks and lots which have been officially approved and recorded. These subdivisions are tied to the original PLSS grid and should also ideally be tied to geodetic control points, although most often they are not. Together, the original PLSS grid and these subdivision plats provide the underlying legal framework for defining the shape and location of most property parcels.

What Constitutes a Property Parcel. The property parcel is the fundamental unit of the multipurpose cadastre in general and the cadastral data layer(s) in particular. Consequently, how a property parcel is defined is a major factor influencing the basic design of the cadastral layer and the multipurpose utility of the information. Early in GIS/LIS design process, careful consideration should be given to this issue to determine that the parcel definition used in the development of cadastral data layers will ultimately support the types of analysis and applications desired for the GIS/LIS.

The National Research Council, in its publication, Procedures and Standards for a Multipurpose Cadastre, provided the following broad definition of a cadastral parcel, *"an unambiguously defined unit of land within which unique property interests are recognized."* [4] The Multipurpose Land Information Systems, The Guidebook built on this parcel definition, by noting that there are many land rights and interests, with each right or interest representing a stick in the bundle of legal interests in a community. *"A parcel is an unambiguously defined unit of land within which a bundle of rights and interests are legally recognized in a community. A parcel encloses a contiguous area of land for which location and boundaries are known, described, and maintained, and for which there is a history of defined, legally recognized interests."* [5] The Guidebook further broadens the perspective it offers by also citing the following definition, *"A parcel is a continuous area of land described in a single description in a deed or as one of a number of lots on a plat, separately owned, either publicly or privately; and capable of being separately conveyed. For ease of indexing data, a segment of a street, highway, railway right of way, pipeline, or other utility easement may be treated as though it were a parcel."* [6]

The last definition provides an illustration of the range of uses and definitions that the concept of a property parcel may have. This definition recognizes that for the ease of indexing information related to specific property rights, it may be practical to consider right-of-way areas and utility easements as parcels. In some areas with complex patterns of land ownership and land use rights, this approach of designating separate parcels for easement and right-of-way areas has been incorporated into the land record management system. When these local governments move their land records to a computerized GIS/LIS, these easement and right-of-way parcels are usually integrated into their GIS/LIS system. For most local governments, there are two common definitions and/or uses of the property parcel concept. One common use of the concept is related to the legal/government subdivision of land and it is based on

[4] National Research Council, 1983: *Procedures and Standards for a Multipurpose Cadastre,* National Academy of Sciences, Washington, DC, 55 p.

[5] Federal Geodetic Control Committee, January 1993: *Multipurpose Land Information Systems, The Guidebook,* "The Parcel Map", 13-2, 3 p.

[6] Moyer, D. David, and Kenneth P. Fisher, 1973: *Land Parcel Identifiers for Information Systems,* American Bar Foundation, Chicago, IL.

the PLSS grid, the PLSS aliquot parts, and/or officially recorded subdivision plats. The other common definition or use of the concept of a property parcel is based on actual land ownership patterns. In this definition, when several legal/government subdivided areas are contiguous and owned by the same entity, they may be considered one parcel. For example, if one person owns three adjacent city lots, the County Assessor may consider all three of those lots as one property parcel for their assessment records.

This latter approach to defining a property parcel can be seen in the Nebraska statutes and Nebraska Department of Property Assessment and Taxation Regulations that govern local government assessment practices. The Nebraska statutes define a parcel for assessment purposes as follows:

> *If a whole section, half section, quarter section, or half quarter section belongs to the same owner, it shall be included in one description. If all the lots in the same block belong to the same owner, they shall be included in one description. If several adjoining lots in the same block belong to the same owner, they shall be included in one description. If any item of real property is situated in more than one tax district, the portion thereof in each district shall be listed separately.* [7]

In addition, the Nebraska Department of Property Assessment and Taxation's Real Property Regulations provides the following parcel definition for assessment record-keeping purposes:

> *Parcel shall mean a contiguous area of land under one ownership and one general use and containing not more than one section (640 acres).* [8]

In designing and implementing a local government GIS/LIS, it is important to consider the implications of the different definitions and uses of the property parcel concept. At a minimum, serious consideration should be given to incorporating the data and organizational structure necessary to support both the legal government land subdivision concept and the land ownership pattern concept of property parcels and their related applications. Incorporating the data related to these two concepts of property parcels will provide the foundation for a wide variety of GIS/LIS applications common to local governments. In making decisions related to incorporating other definitions or uses of property parcel data, one must weigh the potential benefit of these other uses versus the costs necessary to support these other applications. These costs include both the initial investment required to develop the original GIS/LIS data and the on-going costs associated with maintaining this dynamic information.

Graphic and Non-Graphic Cadastral Data. As with most GIS/LIS data layers, a cadastral layer consists of two basic types of data: graphic and nongraphic. Each of these data types has specific characteristics, and each has different requirements for efficient data collection, storage, and display. Because of the differences between these data types, we will discuss the cadastral graphic data and the cadastral attribute (nongraphic) data separately in this section.

Cadastral attribute (nongraphic) data includes additional information about property parcels and other mapped features and will be discussed later in this section. For example, cadastral graphic data contains boundary lines and property parcel polygons (closed geometric figures), each with unique identifiers. The term unique identifier refers to a unique number that is used by the computer system to reference either a graphic feature (a specific point, line or polygon) and/or its related attribute information. The non-graphic attribute data uses these unique identifiers for the boundary lines and property parcels to relate them to additional information about the line, such as its bearing and distance as recorded in a deed, and additional information about particular parcels such as its area and ownership (see Fig. 19).

[7] Nebraska Legislature, *Reissued Revised Statutes of Nebraska, 1943,* Lincoln, NE, Section 77-1303

[8] Nebraska Department of Property Assessment and Taxation, 8/99: *Real Property Regulations, Title 316, Chapter 10*, Lincoln, NE, 10-001.09.

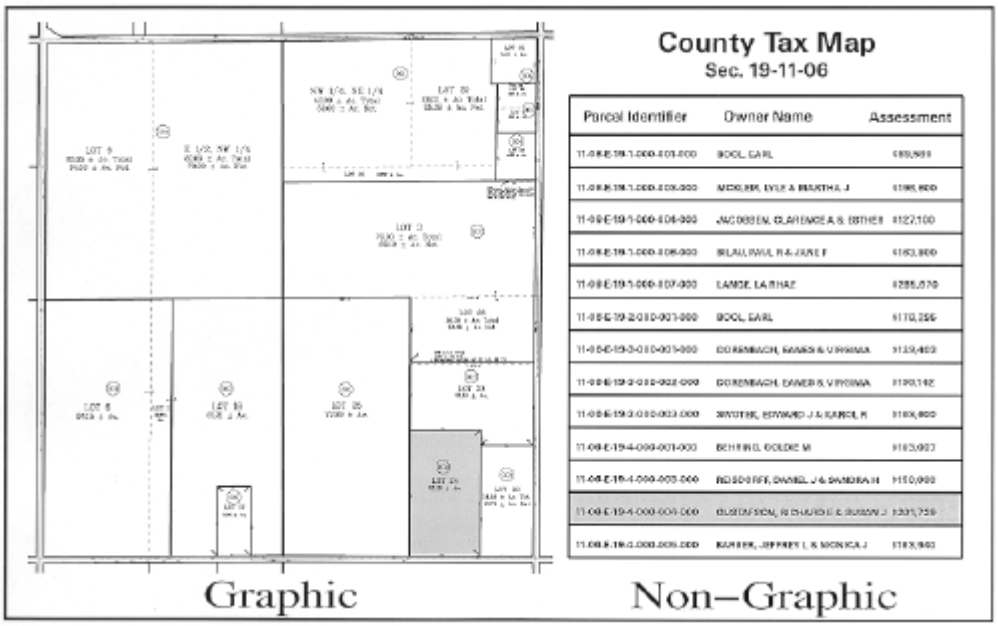

Fig. 19. Example of graphic and non-graphic attribute data related to a common property parcel.

Graphic Cadastral Data. The graphic component of cadastral data refers to the graphic information that describes property parcels. In the publication, GIS Guidelines for Assessors, these graphic cadastral data are described as:

> *¼ including property corners, boundaries, and parcels of land. Typically, property corners are coordinates for points on the parcel boundaries and identifiers for the corners. These identifiers allow graphic cadastral features to be tied to related attribute information. Boundaries are lines between corners, line topology that describes who owns land on either side of the line, and an identifier for the line, which allows it to be tied to attributes. In cadastral data, parcels of land are polygons (closed geometric figures) and an identifier for the polygon that relates the parcel to attribute information related to that parcel.*[9]

Elements of Graphic Cadastral Data. As was noted above, property parcels can be defined in several different ways. The ways in which parcels are to be defined, for a given GIS/LIS and its desired applications, determines the shape and location of the graphic cadastral data elements. A closer look at the specific cadastral data elements illustrates some of these differences for legal government parcels and land ownership parcels (see Fig. 20).

- **Property corners** (points)
  - Property corner data consists of data about legally-defined points on the earth's surface, including the locational coordinates for each corner point and a unique identifier used to reference attribute information related to each corner point.
  - Legal government property corners consist of the PLSS section corners, quarter section corners, and corners defined in legally filed subdivision plats.
  - Land ownership property corners consist of all the corners required to define land ownership parcels. In rural Nebraska these land ownership corners are usually either PLSS section corners, quarter section corners, or corners derived from those corners (subdivisions between these PLSS corners, .i.e., 1/16 section, or measurements in relationship to these PLSS-based corners). In urban areas these property corners are usually corners defined in legally filed government subdivisions, or derived from those corners.

[9] Urban and Regional Information Systems Association and International Association of Assessing Officers, 1992: *GIS Guidelines for Assessors*, Washington, DC and Chicago, IL, 11-13 p.

- **Property boundaries** (lines)
  - Property boundaries consist of lines between the various property corners, with each individual line having a unique identifier that can be used to reference that line to attribute information that is related to that particular line.
  - In addition to the coordinates that define the location, shape, and length of a line, a GIS/LIS is also capable of storing information about what is adjacent to either side of a line. This powerful capability is known as topology and allows the GIS/LIS to reference the different property parcels that exist on either side of a given line.
  - Most land ownership parcel lines will follow existing legal government parcel lines. An exception would be when an existing subdivision parcel is split between two or more owners, such as when two adjacent owners might split an existing subdivision-defined lot between them. A new boundary line is created by this split of an existing subdivision lot and therefore this boundary line would not follow an existing subdivision lot line.
- **Property parcels** (polygons)
  - Property parcels are the polygons or closed geometric figures that represent the location, dimensions and shape of a property parcel as defined in legal description of the related property parcel's deed. It should be noted that the boundaries of the property parcels consist of, and are defined by, the property corners and property boundaries, which are outlined above.
  - In many cases, the land ownership property parcel polygons will coincide with legal government property parcel polygons, exceptions are when multiple adjacent subdivision parcels are combined under one owner or when a legal government parcel is split between two or more owners.
  - In a GIS/LIS each property parcel polygon must have a unique identifier, which is used to associate individual parcels with related non-graphic attribute information. For land ownership property parcels, this identifier is commonly known as a Parcel Identification Number (PIN).

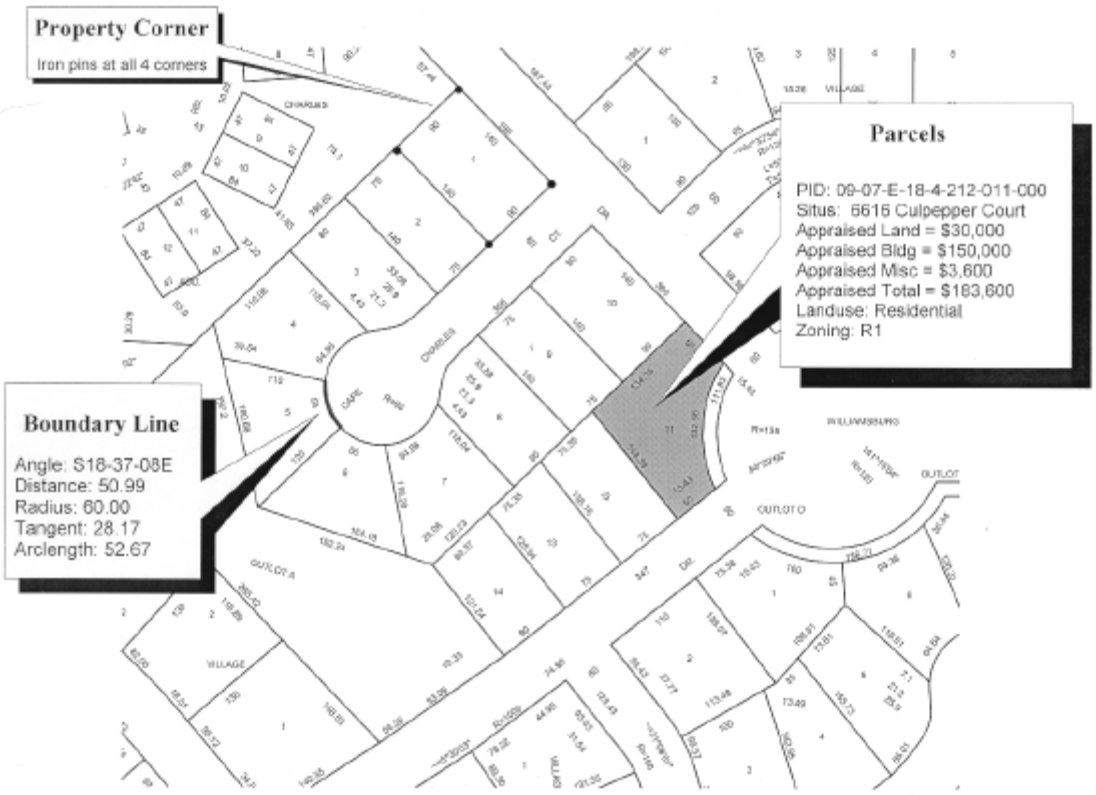

Fig. 20. An example of Property Corners (points), Property Boundaries (lines) and Property Parcels (polygons).

As the description above indicates, the graphic components of cadastral data consist of the points, lines, and polygons that define the location and shape of a property parcel within a GIS/LIS. These three types of graphic elements are interrelated for any given property parcel. The corners define the lines, and the lines define the polygon boundaries. The fact that these graphic elements are separately defined and discussed is both a reflection of the importance of each of these elements in legal land records, and of how this data is organized internally within a GIS/LIS.

Which Property Parcel Concepts Should Be Incorporated Into The Cadastral Data. The shape and location of these graphic cadastral data elements vary relative to the property parcel definition used or needed for the planned GIS/LIS applications. Two common definitions of property parcels that are used in a wide range of local government applications are the legal government parcel and the land ownership parcel (see Fig. 21). Other uses of the concept are to define and index records related to easements and rights-of-way. Early in a GIS/LIS development effort, it is important to consider the desired applications that relate to property parcel data and weigh the benefits versus the costs associated with capturing and maintaining the cadastral data associated with the different definitions of property parcels.

Two graphic data layers are necessary to provide the foundation for a wide variety of local government GIS/LIS applications. It is recommended, that at a minimum the cadastral data elements associated with: a) property parcels defined through legal government land subdivision and b) those associated with property parcels defined by land ownership patterns be captured as part of the graphic cadastral data layer(s). These graphic cadastral data elements include the locational coordinates for points representing parcel corners, topologically constructed lines between parcel corners representing parcel boundaries, and closed polygons representing the area included in a parcel.

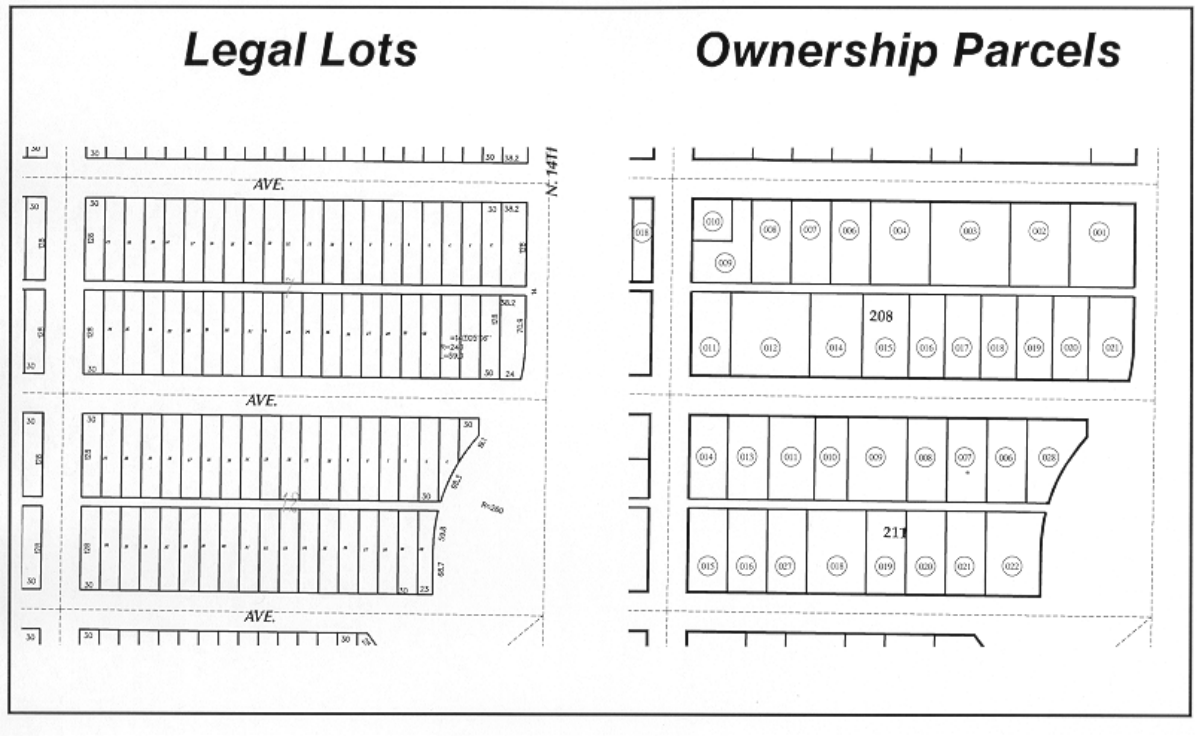

Fig. 21. An example of the difference between Legal Lots and Ownership Parcels.

When the decision is made to collect cadastral data based on multiple definitions of property parcels, a related decision must be made as to whether these graphic data elements will be incorporated into a single graphic layer or multiple layers, each containing the graphic cadastral elements related to one property parcel definition or concept. Both approaches can be successfully employed. Developing separate layers

for the graphic elements that relate to different property parcel definitions provides increased flexibility in the use of the data and is therefore the preferred approach. However, this increased flexibility may be accompanied by somewhat higher development and maintenance costs for the separate graphic layers. If it is decided to combine the graphic cadastral elements related to differing definitions of property parcels into one graphic layer, it is important that they are coded in a manner that enables the elements related to the different concepts to be identified, analyzed and displayed uniquely from the elements related to the other property parcel concepts.

Developing the Graphic Cadastral Data Layers. In section VII of this document, it was recommended that to provide a foundation for a local government multipurpose land information system, a PLSS base map should be developed. It was recommended that this PLSS base map include all of the original government (PLSS) corners tied to the National Spatial Reference System and have a level of spatial accuracy appropriate to the range of applications planned for a given area. A PLSS base map, which meets these conditions, will provide a solid foundation for development of any cadastral data layer(s).

For rural Nebraska, such a PLSS base map will provide most, if not all of the legal government parcel corners from which the parcel boundary lines and polygons are developed. The only missing pieces that would be required to complete a legal government cadastral layer are the officially recorded subdivisions, and their blocks and lots. These officially recorded subdivisions were tied originally to PLSS corners and were designed to accommodate more dense settlement patterns. In the urban/suburban areas of Nebraska, most of the property parcels will be based on these officially recorded subdivisions.

The PLSS base map provides the foundation for the development of all graphic cadastral data features. Further development of these graphic cadastral data features may use existing subdivision or parcel maps or may require the compilation of new maps from legal and other source materials. Most counties maintain tax maps that show all legal parcels. However, these maps often are used merely as an index or inventory, and positional accuracy is not high. Other organizations, such as planning departments, public works, and utilities, also may maintain parcel or subdivision maps. Before beginning to develop a cadastral data layer, a review should be made of available parcel maps to determine if any will be satisfactory as source material.

The publication, GIS Guidelines for Assessors, provides guidelines for evaluating existing maps as potential source material for developing graphic cadastral data features. It suggests a review, which should include answering the following questions about existing maps:

- Were the maps originally drafted from deeds, surveys, and subdivision plats?
- Do the original land base [base map] and parcel maps meet the GIS accuracy requirements? *(see section VII, page 5)*
- Have the maps been maintained on a regular basis?
- Do the current maps visually edge match?
- Are the current maps defined at an acceptable scale? (When a more accurate land base is being used and parcels are to be fit to the new base map, different scales can be a problem. When 1" = 400' maps are to be matched to a new base map at 1" = 100', the potential for problems increases substantially.)

This joint publication of the IAAO and URISA suggests that if the answer to any one of these questions is "no," it may be necessary to perform a recompilation from original deeds, plats and surveys. If the answer to these questions is "yes," it may be possible to digitize or scan the existing maps.

The publication suggests that there are several circumstances in which it may be preferable or necessary to manually redraft the assessment maps before digitizing:

- the jurisdiction has no assessment maps
- current maps are unusable because of age or condition

- several maps of differing scales are to be correlated in the final database
- a more accurate base map has been recently acquired, and currently mapped features no longer match the new base.

The publication further suggests that although such an action may seem like an excessive amount of work, it can be cost-effective. Because map conversion is best performed quickly and without interruption, problems involving deed interpretation and feature registration should be resolved before digitizing. This process of making sure maps are current and resolving problems is called scrubbing.[10]

The book, Geographic Information Systems - A Guide to the Technology, outlines three general approaches to developing graphic cadastral data features. It notes that if existing maps require little or no modification, digitizing available maps generally is the least expensive and time-consuming approach to development of the cadastral layer. If the positional accuracy of current source maps is not adequate, the book suggests that the accuracy may be upgraded by adjusting the source maps to available survey control data and a planimetric base prior to digitizing *[an accurate PLSS base map could serve this function]*. With this approach, the parcel boundaries are adjusted as necessary to match reference features on the base. This process can make a significant improvement in positional quality with relatively limited additional cost, although it does not affect the legal description, which still may contain errors.

The book suggests that the most thorough method of developing the cadastral layer, required when existing maps are unsatisfactory, is recompilation of parcel maps through research of plats, deeds, and legal records. Boundary lines are compiled from the descriptions as an overlay to the reference base that is used to locate the boundaries in their accurate spatial locations relative to the reference features. The reference base may be a planimetric map or an orthophoto *[or PLSS base map]*. Again, this process will not affect the erroneous descriptions in the legal document, although procedures may be designed to record the conflicts.

Lastly, the book discusses a variation on this approach, which uses coordinate geometry programs (COGO) to generate the parcel map features. The origin, bearings, and distances of parcel surveys or plat dimensions are entered into the COGO programs. The resulting coordinate values are computed and stored in the data base. The displayed parcel graphic images are adjusted to correct their positions interactively. Anomalies between adjacent parcels (where common boundary segments are described differently in adjacent parcel records) are also reconciled interactively to produce an aesthetically pleasing map. In this case, however, the true boundaries should be stored permanently on a separate layer to be available for applications that require depiction of the boundaries at the level of accuracy described in the survey documents.[11]

The Federal Geodetic Control Committee's Guidebook also discusses the problem of inconsistent deed descriptions. It notes that mapping of parcels will often reveal inconsistencies among the description of the same and related parcels that are displayed on the map. Efforts to resolve these inconsistencies when constructing the map can result in a long, expensive process. The Guidebook suggests that a reasonable approach is to map the parcel, relying on those descriptions contained in the attribute files (such as deeds, mortgages, and tax descriptions), which are, in the judgement of the mapmaker, the best representation of the parcel boundary. Then a carefully designed procedure is followed to refine the map over time. This refinement may, in some cases, require the use of land surveys, legal agreements, and court proceedings.

[10] Urban and Regional Information Systems Association and International Association of Assessing Officers, 1992: *GIS Guidelines for Assessors*, Washington, DC and Chicago, IL, 49-50 p.

[11] Antenucci, John C., Kay Brown, Peter L. Croswell, et al., 1991: *Geographic Information Systems - A Guide to the Technology,* Van Nostrand Reinhold, New York, NY, 120-121 p

The final product, no matter what the process, is a representation of the parcels whose usefulness depends upon the quality of the mapmaker's judgement and that of the underlying descriptions.[12]

Annotation. Annotation is the text or labels plotted graphically on a map and in most GIS/LIS systems it is information that is stored with the graphic features. Several sets of annotation are generally used with parcel data. Typical parcel annotation includes parcel number, dimensions, lot number, block number, subdivisions name, PLSS section, township and range, and address. Section 004.02 of the Real Property Regulations of the Nebraska Department of Property Assessment and Taxation, outlines the specific annotation elements that should be on a Nebraska cadastral map (see Fig. 22).

Annotation is often one of the most time-consuming tasks in constructing parcel maps. Placement of the desired annotation poses a composition problem. Cartographic skills are required to place the specific annotations on the map so it can be read and interpreted easily. Since in a GIS/LIS different data layers can be displayed in various combinations at different times, it is best to specify the locations for placement so that the individual sets of annotations will not overlay or interfere with each other. Annotation is put into the system by key entry of the text and by specifying with the cursor, its location and angle of rotation or reference features.

Parcel Identification Numbers. In a GIS/LIS, a system of unique, permanent feature identification numbers is the key to linking a specific graphic element to other information related to that particular element, but which is stored in a separate database. The most common example of this linkage in cadastral data is the Parcel Identification Number (PIN) that is used to link a specific property parcel area or polygon to other information about that parcel that may be stored in databases elsewhere.

Unique feature identification numbers enable a much more efficient storage and organization of data. It allows different agencies, in different locations, to maintain separate sets of data related to the same features (i.e., property parcels), and link them together via the common identifier only when required. For example, an assessor can use a PIN number to reference a parcel's property owner and value, a planning department can use it to reference the parcel's zoning classification, a utility department can use it to reference the current utility service available for that parcel, and a mapping department can use it to reference the location and shape of a particular parcel.

In designing a GIS/LIS, it is important to consider which types of graphic elements should be assigned unique permanent identifier numbers to provide linkages to external databases that contain information about those features. As was noted above, the parcel identifier number (PIN) is a referencing number that is widely used in local government applications. In most local governments, this PIN system is used to refer to property parcels based on land ownership or assessment patterns. In some GIS/LIS, it may also be desirable to establish and maintain a separate unique, permanent identifier system to reference the legal government parcels. For example, in some municipalities zoning regulations are based on legal government parcels and not on ownership parcels. Unique permanent identifiers can also be assigned to parcel corners and used to provide linkages to external databases that contain information related to the different surveys that established the location of those corners.

The incorporation of unique, permanent feature identification numbers in a GIS/LIS can provide a considerable amount of utility and flexibility in the use and organization of cadastral data. However, it is important to consider the resources that will be required to develop and maintain these unique, permanent identifiers for this dynamic data. In developing a GIS/LIS, the benefits of a system of permanent, unique feature identifiers must be weighed against the costs of developing and maintaining the data system. This

[12] Federal Geodetic Control Committee, January 1993: *Multipurpose Land Information Systems, The Guidebook,* "The Parcel Map", 13-3, 6 p.

Excerpt from Title 316, Chapter 40, **Real Property Regulations**
Nebraska Department of Property Assessment and Taxation. 2-550-85 Rev. 8-99

REG-40-004 RECORD KEEPING

...

Cadastral Maps

004.02 Every county shall prepare and maintain yearly a cadastral map system. It shall consist of a series of sheets and books showing each parcel of land accurately to scale. As many of the following items as are pertinent shall be shown on each sheet:

004.02A General

Annotation (1) Title of map
Annotation A. Township
Annotation B. Range
Annotation C. Section or sections
Annotation D. Subdivision
Annotation E. Block
Annotation F. Parcel
Annotation (2) Book and page number as found in the register of deed's office
Annotation (3) City
Annotation (4) Arrow indicating north
Annotation (5) Scale of map
Annotation (6) Page number of bordering maps on respective edges

004.02B Descriptive information

Annotation (1) Sections, townships, and ranges if more than one
Annotation (2) Subdivisions if they cover only a portion of the map and are not in the title
Graphic & Annotation (3) Property ownership lines with essential courses and distances-shown by solid lines
Graphic & Annotation (4) Dimensions of lots and tracts-showing original plotted areas in dotted lines if parcel includes a greater area
Annotation (5) Lot number shown in the center of the lot
Annotation (6) Parcel number - which shall be circled or otherwise highlighted on the parcel
Annotation (7) Original block number
Annotation (8) Assessor's block number, which shall be enclosed elliptically or otherwise highlighted
Annotation (9) Acreage of any parcel containing one acre or more, or fractions thereof, or if the county has implemented a lot and block system of identification, then the lot and block
Annotation (10) Width of streets and roads

Annotation 004.02C Street names
Annotation 004.02D Highway route numbers designating whether federal, state, or local
Annotation 004.02E Ownership and use of public property (courthouse, library, school, park, etc.)
Graphic &/or Annotation 004.02F Creeks, rivers, ditches, bridges, lakes, etc.

Fig. 22. Example of annotation items on a Nebraska cadastral map, as required by regulations.

benefit/cost analysis is necessary for each type of cadastral feature (point, line, and polygon) and for each definition of a property parcel that is incorporated into the GIS/LIS cadastral data structure.

> ***A system of unique, permanent feature identification numbers is the key to linking specific graphic cadastral features to attribute information related to that particular graphic feature, which may be stored in separate databases. At a minimum, it is recommended that a system of permanent, unique feature identifiers be incorporated into the GIS/LIS for the land ownership parcel polygons, commonly known as Parcel Identification Numbers (PIN).***

All counties in Nebraska maintain some type of PIN system to reference their land ownership parcels. Such a PIN system is required by the Department of Property Assessment and Taxation Real Property Regulations.[13] While the specific structure of these PIN systems vary widely from county to county, most of them could probably be adapted for use within a GIS/LIS system.

Merits of a Common Statewide PIN. As more and more local governments develop GIS/LIS systems, there is a growing concern about the ability to integrate this GIS/LIS data across jurisdictional lines. For example, it would be very convenient and a cost-effective use of taxpayer resources for local governments and natural resources districts to cooperate in the development and maintenance of commonly needed databases. However, most natural resources districts cross county boundaries and would need to integrate property parcel data from multiple counties. The adoption of a common PIN system would facilitate this integration process.

There are many ways to logically structure a workable PIN system. One logical PIN construction is proposed here, in an effort to stimulate a dialogue about both the merits of a common statewide PIN system and about how such a system could be structured. This is not to state that this proposed PIN is inherently superior to other existing PIN systems, but only that it offers a logical, clear construction that could serve as the basis of a common statewide PIN system. One of the strengths of this proposed PIN construct is that it is clearly based on the PLSS and subdivision block/lot system of land subdivsion and ownership.

The adoption of such a PIN system by local governments, as they transition their land records to a GIS/LIS, would enhance the ability of public entities to share data and system development and maintenance costs. Upon adoption of such a statewide PIN, access and reference to documents filed and recorded under a previous PIN system could be facilitated by the one-time development of a cross-reference table. Clearly before such a statewide system could be implemented, additional discussion would be needed with local governments and state agencies such as the Department of Property Assessment and Taxation.

As a stimulus for those discussions, the following structure is proposed for a common, statewide, twenty-digit PIN number (see Fig. 23). The last three digits of this proposed PIN are designated for a Sub Parcel and could be used in the case of condominiums setting on one parcel but having multiple PIN numbers, etc.

2 digits.....Township	3 digits .....Subdivision
2 digits.....Range	3 digits .....Block
1 digit .....Range Direction	3 digits .....Parcel
2 digits.....Section	3 digits .....Sub Parcel *(condominiums, etc.)*
1 digit .....Quarter Section	

[13] Nebraska Department of Property Assessment and Taxation, 8/99: *Real Property Regulations, Title 316, Chapter 10*, Lincoln, NE, 10-004.03.

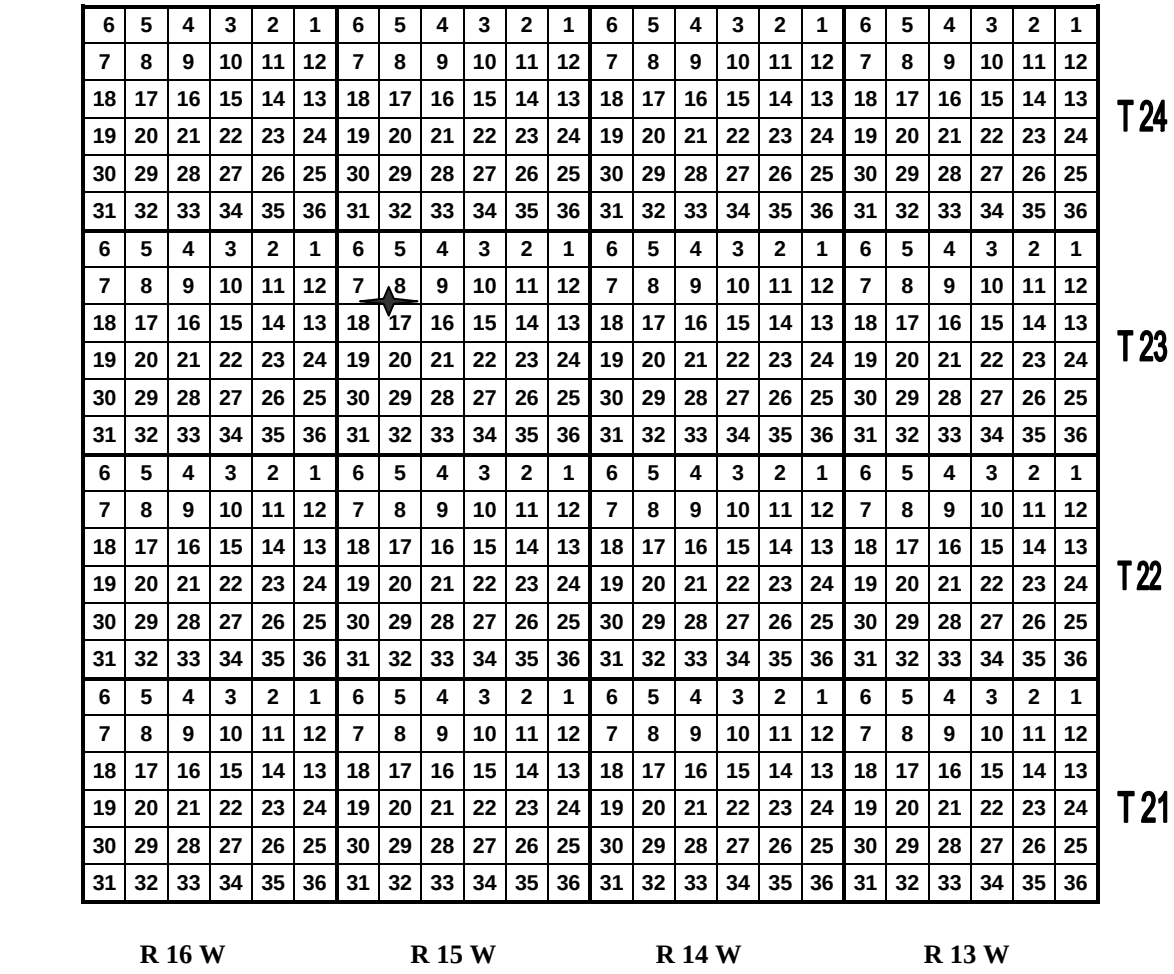

Fig. 23. Proposed Statewide Parcel Identification Number (PIN).

Cadastral Attribute Data. Attributes are the characteristics of a graphic map feature that are described by alphanumeric characters which are typically stored in a tabular format, and linked to the graphic map feature by a user assigned identifier. For example, attributes of a property parcel might include: area, ownership, zoning, or value and might be linked to the property parcel graphics by a PIN. One of the distinguishing characteristics of a GIS or MPLIS from a CAD (Computer Aided Drafting) system is the ability of a GIS or MPLIS to easily associate a wide array of attribute data with graphic data. This ability to link, display, and/or analyze cadastral data based on its graphic components, or its related tabular attribute data, or a combination of both is one of the great strengths of these systems.

To provide the foundation necessary for a wide variety of local government applications, it is recommended that non-graphic, attribute data should be organized within the MPLIS which describes individual property parcels relative to their basic parcel characteristics, tenure, value, history, buildings and units within the parcel, and tax status. Much of this attribute data will already exist in separate databases within a variety of local agencies.

Utilizing and Linking Existing Databases. In most cases, much of the cadastral attribute data needed for a local government MPLIS will already be available in a variety of computerized databases that are maintained by an assortment of local government agencies. For example, the offices of the assessor, register of deeds, public works, public safety, or public utility agencies might all maintain separate databases that contain information related to property parcels. A MPLIS commonly consists of a set of interconnected databases to support its multiple operational information applications. The extensive investment that many local governments have made in computerizing data over the last 30 years prohibits a complete restructuring of databases to create a single database to support such diverse applications. Combining all information into a single database would also create a land information management nightmare from an institutional perspective, and in many cases adversely impact the specific applications for which the databases were originally built. However, the diversity in applications of data does not prohibit an organization from bringing together these diverse sets of data for more effective use. As long as the various databases contain common data elements or identifiers that can serve as a logical link between databases, there is no need to combine all parcel-related data into a single database.

In the development a MPLIS, the investment of interagency planning resources in the careful development of a shared system of data linkages can pay dividends in several areas. Technically, data linkages can reduce or eliminate redundancy by systematically relating various data sets. The data linkage can support easy access to data when such access is permitted. Economically, data linkages reduce the cost of data maintenance, and information use becomes more effective through a broadened information context. Institutionally, data linkages tend to foster cooperation among parts of an organization (or organizations) regarding land information issues.[14]

As was noted above, Parcel Identification Numbers (PINs) are a common example of how permanent unique feature identification numbers can be used to link graphic cadastral features (polygons representing property parcels) to non-graphic, attribute data related to those same parcels. These same PINs can also serve as a data link between a variety of databases containing property parcel data — as long as the PINs are common data elements in each of the cadastral attribute databases. The permanent identifiers of other types of graphic features can also serve these dual-linking functions, as long as they are present in each of the databases. However, other data elements common to all the databases to be linked can also serve this linking function, and it is not necessary that they also serve as an identifier and link to a graphic data element.

In developing a system to link databases, it is important to carefully determine that you are linking or equating the same phenomenon, and not inadvertently equating apples with oranges. An example is the land parcel, which is a real-world phenomenon that is of basic importance to many applications in local governments. However, as we have discussed before, different kinds of parcels exist, depending on the function of an organization. For example, a tax parcel maintained by an assessor may not, in fact, be equal to a development parcel maintained by a building and development department, and an ownership parcel may be different from both the development and tax parcels. Definitions should be developed to define the explicit character of these entities, and these differences in character must be recognized to

[14] Federal Geodetic Control Committee, January 1993: *Multipurpose Land Information Systems, The Guidebook,* "Data Linkages In a MPLIS", 10-1 p.

avoid confusion when decisions are made, or when data are borrowed and/or shared among parts of an organization.

Parcel Index. In developing a MPLIS, it is frequently not feasible to have a single parcel identifier because of institutional histories. This is particularly true across local government agencies, but also might be the case within an agency. If multiple identifiers are used, a cross-index must be used to facilitate storage and retrieval of the same parcel regardless of the naming system. For example, "street address" and "section, plat, and lot number" should have a cross-reference in a look-up table. However, one of the identifiers should be institutionally recognized as the principal one.[15]

A set of data containing all identifiers for each property parcel is commonly known as a Parcel Index. The index will have an entry for each parcel throughout the jurisdiction. The index will provide capacity for each of the possible identifiers used by, or of interest to, the various participating organizations. Each parcel will be assigned a unique identifier, commonly known as a Parcel Identification Number (PIN). To preserve uniqueness, it will be necessary to assign new identifiers to all parts of a parcel when a parcel is divided. The parcel index will be used by all parcel access applications to verify an identifier entered and to retrieve any other identifier(s) required by the application. The parcel index may contain the following data items and/or others relevant to a particular local government situation:[16]

- Parcel Identification Number
- Site Address
- Mailing Address(es)
- Place Name
- Parent Parcel Number
- Child Parcel Number(s)
- Subdivision/Lot Number
- Deed Book/Page Number(s)
- Subdivision Index
- Unit Number (Condo, apartment, commercial)
- Owner Name
- Related Same Owner Parcel Number(s)
- Archive Index

Parcel Characteristics Data. Attribute data describing the characteristics of each property parcel is a focal point of any local government MPLIS. Because of the dynamic nature of this data, it needs to be organized in a manner that will facilitate its maintenance on a regular basis. This parcel characteristics data will be used by numerous MPLIS applications.
Depending on the software used, the agencies involved, and the particular MPLIS design, this core attribute data can be organized in a variety of interconnected databases. While the organizational approach is flexible for this data, there is a reasonable level of agreement on the types of data that will be needed. Both the MPLIS: The Guidebook[17] and Geographic Information Systems: A Guide to the Technology[18] offer similar suggestions for the types of nongraphic, property parcel characteristics data that will be needed for a MPLIS. These seven general types of nongraphic parcel characteristics data are listed below, followed by a more detailed discussion of each data type.

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[15] Federal Geodetic Control Committee, January 1993: *Multipurpose Land Information Systems, The Guidebook,* "Data Linkages In a MPLIS", 10-9 p.

[16] Federal Geodetic Control Committee, January 1993: *Multipurpose Land Information Systems, The Guidebook,* "Automation Components", 22-33,37 p.

[17] Federal Geodetic Control Committee, January 1993: *Multipurpose Land Information Systems, The Guidebook,* "Automation Components", 22-33,37 p.

[18] Antenucci, John C., Kay Brown, Peter L. Croswell, et al.: *Geographic Information Systems - A Guide to the Technology,* Van Nostrand Reinhold, New York, NY, 124 p.

- **Basic Parcel Characteristics**
- **Parcel Tenure Characteristics**
- **Parcel Value Characteristics**
- **Administrative Characteristics**
- **Building Characteristics**
- **Unit Characteristics**
- **Tax Status.**

Basic Parcel Characteristics. At the core of the land information system is the basic parcel characteristics data that will be shared by most applications. The data describe the basic characteristics of the land parcel, including its physical description, use, condition, and other characteristics. A common list of basic parcel characteristics includes:

- Parcel Identifier
- Topography Class
- Area
- Road Class
- Frontage
- Non-developed Class
- Depth
- Mobile Home Code
- Land Use(s)
- Zoning(s)
- Number of Buildings
- Building Identifiers
- Number of Units
- Unit Identifiers
- Utilities Available
- Development Status
- Parking Spaces
- Well/Septic sites
- Swimming Pool
- In-Floodplain
- Slope Classification

Parcel Tenure Characteristics. This data will contain information describing the ownership status and history for the parcel and will include entries for all owners of each parcel throughout the parcel's history. Common tenure data elements include:

- Parcel Identifier
- Legal Description
- Owner Name(s)
- Prior Owner Names
- Parent Parcel Number(s)
- Child Parcel Number(s)
- Sale Dates
- Deed Book/Page Numbers (Current and Past Deeds)
- Easements
- Covenants

Parcel Value Characteristics. Tax appraisal is one of the major applications of most MPLIS. Through the use of a computer-assisted mass appraisal (CAMA) system, much of this application can be automated. The CAMA appraisal process make use of a broad range of data to compute real estate values. Commonly required parcel-related valuation data elements include:

- Parcel Identifier
- Commercial/Residential Code
- Land Values
- Total Value
- Improvement Values
- Sale Price
- Sale Date
- Prior Sale Prices
- Prior Sale Dates
- Agricultural Program Status
- Agricultural Program Value(s)
- Exemption

Administrative Characteristics. A local government performs a variety of functions related to parcels for which information records are maintained. These activities include zoning, subdivision review, health, and other cases. Administrative records describing various incidents related to parcels are also created for emergency services and other functions. Indexes to these cases and incidents may be maintained in the parcel records to facilitate identification of information and activities on parcels. Data on each case or incident related to the parcel are recorded with an entry for each case or incident. These data are updated from the related administrative activities. The case and incident data may include:

- Parcel Identifier
- Administrative Case Numbers
- Permits
- Active Cases
- Active Case Status
- Development Conditions/Limitations
- Incident Identifiers
- Development Activity Codes

Tax Status. Tax billing is a vital function that is closely related to land records, relying on up-to-date parcel identification, ownership and tax status data for timely collection.

- Tax District
- Tax Bill Amounts
- Tax Accounts Receivable
- Payment Status
- Tax Claim Status

Building Characteristics. Data on buildings associated with each parcel are required for computer assisted appraisal procedures, as well as numerous other functions throughout a typical local government. Data will be maintained for each building and it will be related to the parcel on which the building resides.

Unit Characteristics. Increasingly, many parcels include buildings that have multiple-occupancy residential or commercial units for which information must be recorded. This unit data will be used for automated appraisal, emergency response, and several other functions.

Data Standardization and Documentation. In addition to developing data linkages between the existing parcel-related attribute databases in different agencies, data standardization and documentation are two additional keys to the successful incorporation of these databases within a MPLIS.

If data are to be shared among the various functions and agencies within a jurisdiction, it is necessary to establish a set of standard coding schemes, data names, naming conventions, and definitions for each data element. The definitions should describe the contents of the element, the characteristics of the data representation, and any coding schemes used to record the data. The multiple, conflicting definitions of parcels between the offices of the assessor, the register of deeds, and the building/development agency are examples of the importance of these definitions. The establishment of standards also requires that procedures be established to inform users of the standards and to monitor the MPLIS to ensure continuous compliance with these standards.

There is also a need for standardization of certain data sets for shared use. Foremost among these are the street names and addresses. It is very helpful to compile and maintain a comprehensive set of street names and addresses or address ranges for the jurisdiction. This standard set should then be used by all address-related applications throughout the land records system.[19]

In addition to data standardization, the systematic documentation of graphic and attribute databases is another important component in the development an integrated MPLIS which spans multiple databases and departments or agencies. Systematic efforts to develop and maintain a detailed documentation of the data sources, scale, quality, and spatial references, as well as the meaning of attribute terms and codes, are key factors in enabling multiple users to appropriately apply data from a variety of agencies and sources. The development of this documentation is also the key to enabling a local government to maintain its investment in the value and information incorporated into a database when the personnel who developed the database are no longer available. Metadata is the technical term used to describe this "data about data" (see Fig. 24).

National standards have been developed for geospatial metadata, "Content Standards for Digital Geospatial Metadata"[20], by the Federal Geographic Data Committee (FGDC) and these standards have also been endorsed by the Nebraska GIS Steering Committee. These metadata standards provide a systematic framework for documenting the various components of a geospatial database. Because this documentation process is rather tedious and because the person doing the documentation already knows the information, there is a tendency to defer or to not systematically insure that this database documentation is completed. This is an implementation mistake that should be avoided. Database documentation is most efficiently completed as part of the initial database development and should be incorporated into those efforts.

The "Content Standards for Digital Geospatial Metadata" is focused on documenting a database as a whole, assuming a fair degree of uniformity in terms of the source and quality of data in the database. This uniformity is frequently not the case with cadastral data, i.e. some surveys are much more accurate than others and the data is typically pulled from a variety of sources. In an attempt to develop a documentation framework more appropriate for cadastral data, the FGDC has also developed, "Cadastral Data Content Standards for the NSDI"[21]. These standards provide a framework for documenting the source of individual property parcel corners and boundaries. At the current time these Cadastral Data Content Standards provide only a logical conceptual framework for this documentation, and not an implementation model or tools.

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[19] Federal Geodetic Control Committee, January 1993: *Multipurpose Land Information Systems, The Guidebook,* "Automation Components", 22-39 p.

[20] Federal Geographic Data Committee, March 24, 1995: *Content Standards for Digital Geospatial Metadata Workbook*

[21] Federal Geographic Data Committee, August 1996: *Cadastral Data Content Standards for the NSDI*

Because software vendors have developed tools to facilitate the development and maintenance of the metadata based on the "Content Standards for Digital Geospatial Metadata" this database documentation should be completed. As software vendors work with the FGDC and others to develop tools compatible with the "Cadastral Data Content Standards for the NSDI" the development of this more detailed cadastral specific metadata should be considered.

Sample Questions Related to
Content Standards for Digital Geospatial Metadata

In your database, what definition is used for the term parcel?

When a value of 5 is given in your database for building quality, what does it mean?

How current is the data in your database?

What is the source of the parcel boundary line information in your database?

What is the degree of spatial accuracy of your PLSS section corners?

What map projection is used for your database?

What is the unit of measure for distance that is used in your database: feet or meters?

Who should be contacted for questions related to the meaning of database terms or values?

Fig. 24. Examples of the type of questions used to document databases via metadata.

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